

near the void locations of the actual solution can be seen. In evidence are the strong oscillations in front of the crack tip, where the microvoids are located. In contrast, for a larger distance from the crack tip, the stress values converge to a smooth decreasing trend due to the absence of perturbation caused by microvoids.

### 5.3.2 Geometrically Necessary Dislocations

As last result demonstrated in this article, Fig. 5.6 shows the zones of concentrations of the norm  $\sqrt{G_{ij}G_{ij}}$  of the dislocation tensor

$$\mathbf{G} = J^e \mathbf{F}^{e-1} \text{curl } \mathbf{F}^{e-1} \quad (5.4)$$

as proposed by CERMELLI & GURTIN [2001] at the load level 120. Essential is the fact that the grain boundaries acts as concentrators of the quantity, which is obvious due to the different appearances for the coarse and the fine crystalline substructure.

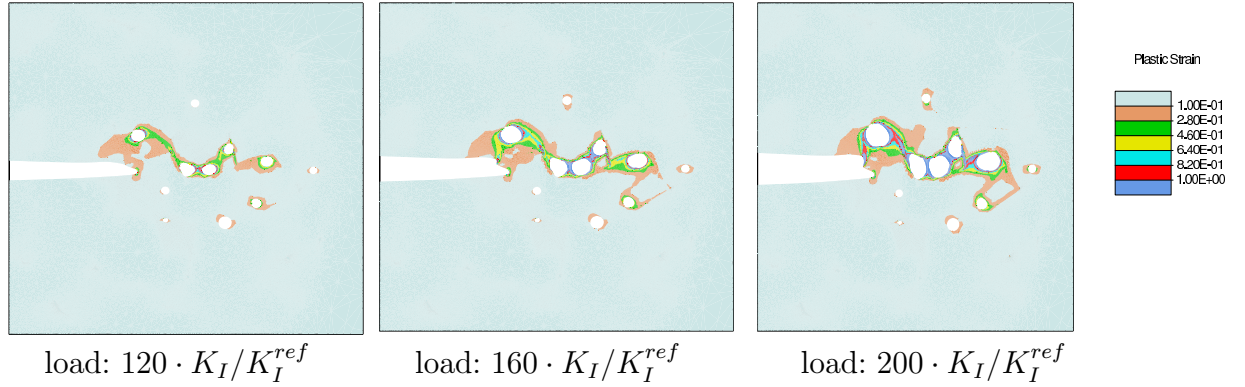


Figure 5.3: Evolution of plastic strain & void growth

## 5.4 Summary

In this contribution we show a study of void growth near a crack tip in the scope of a  $K_I$  far field. Additionally, the near crack tip region is built up by a

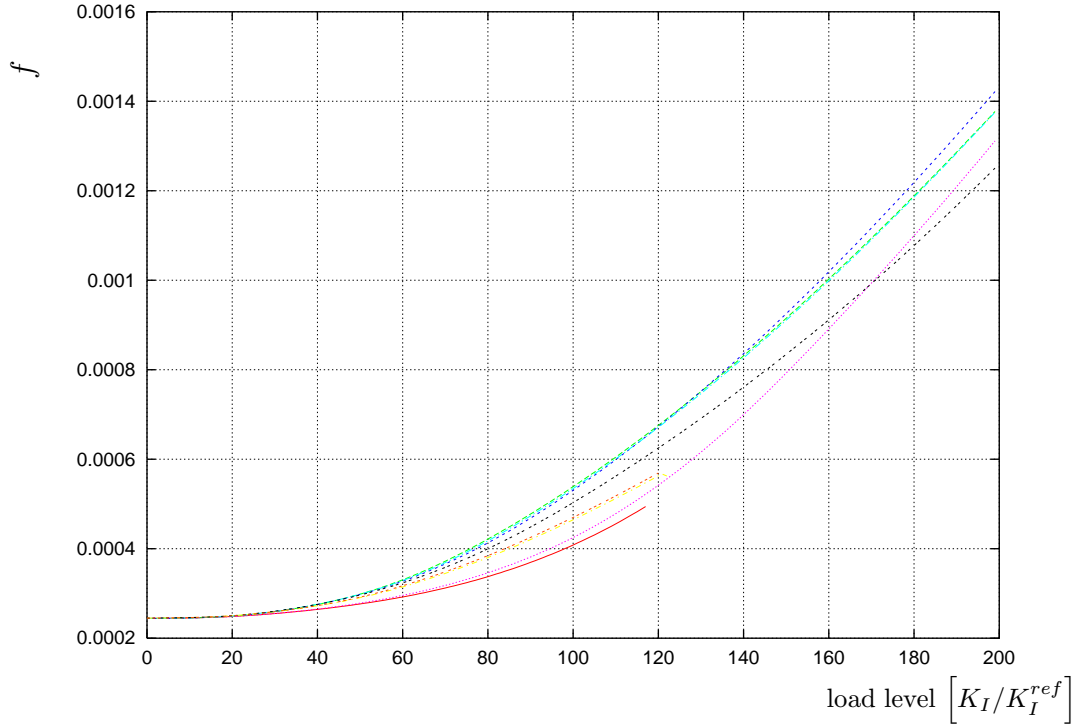


Figure 5.4: Void volume fraction for different material sets

synthetic crystalline microstructure with two different length scales representing different mean values of crystal diameter. Therefore, the void position and radius and as well the material properties of the modeled grains in the surrounding of the crack tip vary randomly. The results confirm the suggestion that in this loading regime just the voids in the direct elongation of the crack tip grow dramatically, while the others beside the ligament are affected non-essentially. The end of the investigation deals with the representation of so called *geometrically necessary dislocations*, which give some insight into the *internal constraints* within the crystals due to plastic flow. This type of microdefects accumulates in the surrounding of the crack tip and especially at the grain boundaries.

These two results may help to understand and to model material behaviour near crack tip singularities in a more accurate and responsible way. Further